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Lumbar canal measurements

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ABSTRACT

Direct measurements of 150 vertebral levels in 30 normal adults were carried out in Manipal, India. The lumbar canal was measured by Eisenstein and Jones techniques. The average figure and the upper and lower limits of normal were reported for the anteroposterior, transverse diamater of the canal, and for the spinal index. The spinal index was less reliable than direct measurements. In comparison to previous studies, the absolute canal diameter in this study is much less. Anteroposterior diameter of the canal less than 10 mm in a lateral radiograph using a standardised technique, suggests the possibility of stenosis.

INTRODUCTION

For many years it was recognised that the lumbar nerve roots could be subject to pressure from narrowing of the spinal canal. The final diagnosis of this condition rests in demonstrating reduced dimensions of the spinal canal. However this is often difficult. Although various methods like CT scan and MRI scan are used to measure the spinal canal, it is not possible to carry out such scans in most of our population because of the socioeconomic conditions. Radiculogram, being an invasive procedure, is used only when surgery is considered.

Unlike the cervical spine, the posterior margin of the canal is difficult to locate in a lateral radiograph of the lumbar spine. Verbiest[4] stated that it was not possible to recognise the anomaly of the narrow canal on a plain radiograph and relied entirely on myelography. Jones and Thompson[2] popularized a technique of measuring canal dimension in relation to vertebral body. Eisenstein[1] established a technique for defining the posterior margin of the spinal canal on plain radiograph and found that the anteroposterior diameter rather than transverse diameter was significant in diagnosing lumbar canal stenosis. Using the same criteria, the spinal canal in our clinical cases of stenosis showed a gross reduction of anteroposterior diameter. Therefore, a prospective study was conducted in 30 normal adults to define normal values of anteroposterior and transverse diameters of the lumbar canal.

MATERIALS AND METHODS

30 normal adult subjects who were working in the Kasturba Medical School in Manipal, India were selected. All were from Udupi, a town of 100 000 population on the West Coast of India. None of them had previous record of backache. There were 22 males and 8 females. The age varied from 20 to 50 years.

Anteroposterior and lateral radiographs were obtained using a standardised technique. The roentgen beam was centred at the fourth lumbar vertebra and a fixed target film distance of 100 cm was employed. The cassette was kept close to the body and magnification

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factor of 1.1 was established for the standard radiograph. The lumbar canal was measured at each vertebral level using the technique of Jones and Thompson[2] and Eisenstein[1] (Fig. 1). All radiological assessment was performed by one of the authors (VP) on 2 occasions, with an interval of one week.

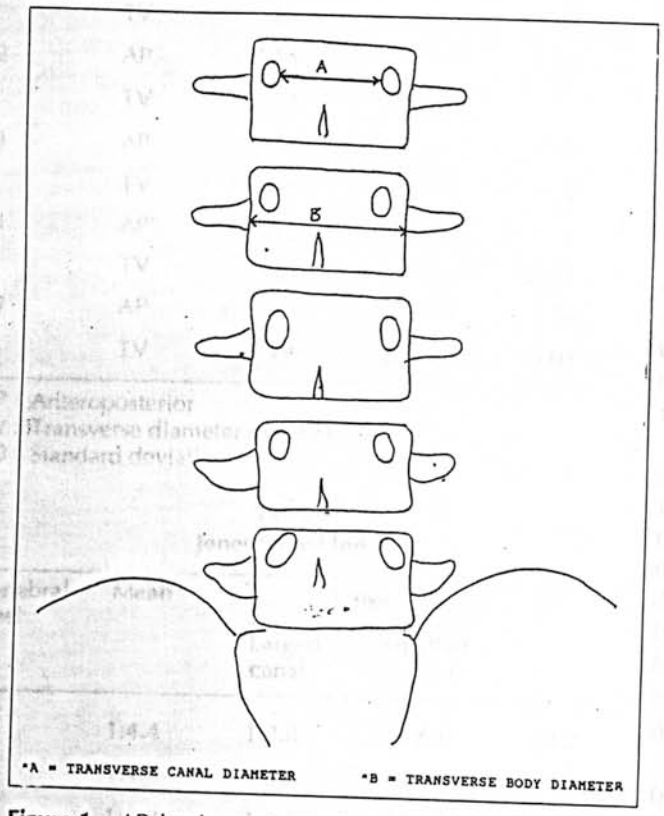

Figure 1 AP lumbar spine: radiograph showing transverse diameter of the vertebral body and spinal canal.

(a) Jones and Thompson's method

The anteroposterior diameter of the spinal canal was measured in the lateral radiograph, from the middle of the back of the vertebral body to the base of the opposing spinous process. Interpedicular distance in the anteroposterior radiograph gave the transverse diameter of the canal.

$$\text{Jones Index} = \frac{\text{Product of anteroposterior and transverse diameter of the spinal canal}}{\text{Product of anteroposterior and transverse diameter of the corresponding vertebral body}}$$

b) Eisenstein's method

Absolute anteroposterior and lateral canal diameters were measured. Transverse diameter was calculated as in Jones method. Anteroposterior diameter (Fig. 2) of the canal was measured as follows:

First tips of the superior articular facets and inferior articular facets of the same vertebra were identified on lateral radiograph. These two points were connected. This line defined the posterior margin of spinal canal. The perpendicular distance from this line to the middle of the body gave anteroposterior diameter of the spinal canal.

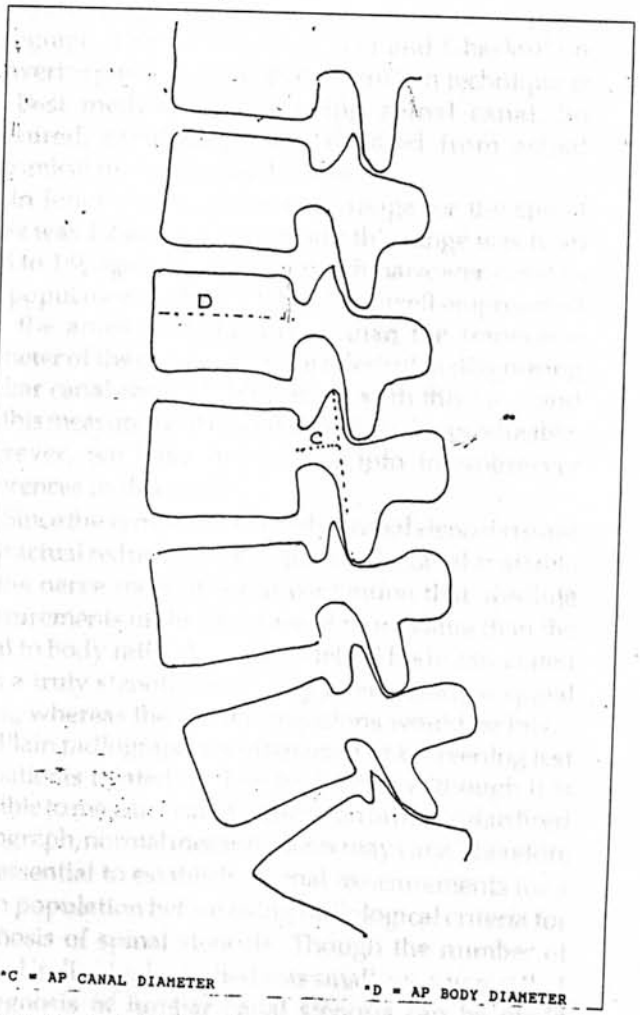

Figure 2 Lateral lumbar spine: radiograph showing measurement of AP diameter of the canal.

OBSERVATIONS

Minimal and maximal values for these measurements were calculated at 95% confidence level (2 SD). These values are shown in Table 1 and Table 2. It has been

Table 1
Actual diameter (in mm) of lumbar vertebral canal by Eisenstein's Method

		Mean	Range	SD
L1	AP	14	11 - 17	1.55
	TV	22	18 - 26	2.01
L2	AP	14	11 - 17	1.14
	TV	23	19 - 28	2.29
L3	AP	14	11 - 17	1.20
	TV	24	20 - 28	2.39
L4	AP	14	11 - 17	1.31
	TV	25	20 - 30	2.61
L5	AP	12	10 - 14	1.37
	TV	29	23 - 35	3.03

AP : Anteroposterior
TV : Transverse diameter of canal
SD : Standard deviation

Table 2
Jones Spinal Index

Vertebral level	Mean	Range		SD
		Largest canal	Smallest canal	
L1	1:4.4	1:2.8	1:6.0	0.82
L2	1:4.6	1:3.0	1:6.2	0.82
L3	1:4.8	1:3.6	1:6.0	0.65
L4	1:5.0	1:3.0	1:7.0	1.07
L5	1:6.0	1:3.0	1:9.0	1.76

observed that there is little difference in the canal of males and females and hence they are considered together.

When radiological measurements were made on a plain film, a magnification factor of 1.1 was established for the standard lateral radiograph which gave a mean anteroposterior canal diameter of 14 mm at L1, L2, L3 and L4 level and 12 mm at L5. Interpedicular distance gradually increased from mean 22 mm at L1 level to 28.5 mm at L5 vertebral level. The canal ratio gradually increased from L1 downwards.

Measurements were found to be reproducible as there was no difference in canal dimension determined on 2 occasions.

DISCUSSION

Only quite recently has it become generally accepted that stenosis of the lumbar canal can give rise to a number of common neurological conditions. In a study of backache, stenosis was encountered next in frequency to nonspecific backache and disc lesions (Pai and Chacko).[3] However, the diagnosis of this entity could not be done using 'normal' values of canal dimensions from Western reports.[1,2] The mean values of anteroposterior canal diameter at every level were less in the population under study.

The main criticism of technique of measuring anteroposterior diameter is inability to define the posterior margin of the spinal canal on a plain radiograph. Our earlier study (Pai and Chacko)[3] on cadaveric spines showed that Eisenstein technique is the best method of measuring spinal canal. So measured, canal dimension differed from actual anatomical dimension by 1.5 mm.

In Jones[2] series, the normal range for the spinal index was 1:2 to 1:4. In our study this range was from 1:2.8 to 1:9, again denoting a much narrower canal in this population (Table 2). It has been well emphasized that the anteroposterior rather than the transverse diameter of the canal was more relevant in diagnosing lumbar canal stenosis. We concur with this view and feel this measurement is both reliable and reproducible. However, we have not looked into interobserver differences in this study.

Since the symptoms in lumbar canal stenosis result from actual reduction of the space in the canal available for the nerve roots, it is our contention that absolute measurements of the canal are of more value than the canal to body ratio. A small vertebral body associated with a truly stenotic canal may have a normal spinal index, whereas the canal dimensions would be low.

Plain radiograph are often used as a screening test for patients treated for low back pain. Although it is possible to measure canal dimension on a standardised radiograph, normal measurements may vary. Therefore it is essential to establish normal measurements for a given population before using radiological criteria for diagnosis of spinal stenosis. Though the number of normal individuals studied was small, we suggest that a diagnosis of lumbar canal stenosis can be made where the anteroposterior diameter of the canal is less than 10 mm. This is further supported by a clinical study of 53 operated cases of lumbar canal stenosis wherein 51 patients with body canal stenosis had anteroposterior canal diameters of less than 10mm (Pai and Chacko).[3]

CONCLUSIONS

Spinal canal stenosis can be diagnosed by plain radiographs of the lumbar spine using a standardized technique. The best method of measuring anteroposterior dimension is by Eisenstein technique. The spinal index is not a reliable index for spinal canal stenosis. Absolute anteroposterior diameter less than 10 mm suggests spinal canal stenosis in lumbar region. However, this measurement may be vary in different populations.

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